



A Publication  
of Reliable Methods  
for the Preparation  
of Organic Compounds

## Working with Hazardous Chemicals

The procedures in *Organic Syntheses* are intended for use only by persons with proper training in experimental organic chemistry. All hazardous materials should be handled using the standard procedures for work with chemicals described in references such as "Prudent Practices in the Laboratory" (The National Academies Press, Washington, D.C., 2011; the full text can be accessed free of charge at [http://www.nap.edu/catalog.php?record\\_id=12654](http://www.nap.edu/catalog.php?record_id=12654)). All chemical waste should be disposed of in accordance with local regulations. For general guidelines for the management of chemical waste, see Chapter 8 of Prudent Practices.

In some articles in *Organic Syntheses*, chemical-specific hazards are highlighted in red "Caution Notes" within a procedure. It is important to recognize that the absence of a caution note does not imply that no significant hazards are associated with the chemicals involved in that procedure. Prior to performing a reaction, a thorough risk assessment should be carried out that includes a review of the potential hazards associated with each chemical and experimental operation on the scale that is planned for the procedure. Guidelines for carrying out a risk assessment and for analyzing the hazards associated with chemicals can be found in Chapter 4 of Prudent Practices.

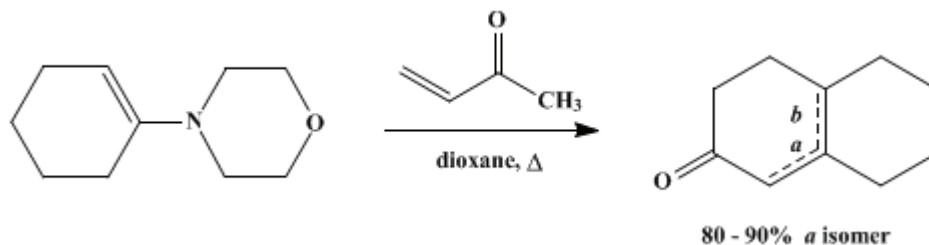
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*These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.*

*Organic Syntheses, Coll. Vol. 5, p.869 (1973); Vol. 45, p.80 (1965).*

## $\Delta^{1(9)}$ -OCTALONE-2

### [2(3H)-Naphthalenone, 4,4a,5,6,7,8-hexahydro-]



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## 1. Procedure

A.  $\Delta^{1(9)}$ -*Octalone-2* and  $\Delta^{9(10)}$ -*octalone-2*. In a 2-l., three-necked, round-bottomed flask equipped with a sealed stirrer, a condenser, and a dropping funnel is placed a solution of 102 g. (0.61 mole) of 1-morpholino-1-cyclohexene<sup>2</sup> (Note 1) in 600 ml. of purified dioxane (Note 2) and (Note 3). To this stirred solution is added 45 g. (0.64 mole) of freshly distilled methyl vinyl ketone at such a rate that the addition requires approximately 1 hour. The resulting solution is heated under reflux for 4 hours, after which time 750 ml. of water is added, and the heating under reflux is continued for an additional 10–12 hours. The solution is cooled to room temperature and poured into 1 l. of water. The resulting mixture is extracted four times with 500-ml. portions of ether. The combined ether extracts are washed three times with 250-ml. portions of 3*N* hydrochloric acid, twice with 100-ml. portions of a saturated aqueous sodium bicarbonate solution, once with a 250-ml. portion of water, once with a 200-ml. portion of a saturated aqueous sodium chloride solution, and dried over anhydrous magnesium sulfate. The mixture is filtered, the ethereal filtrate evaporated, and the residual octalones distilled through a short column. The yield is 54–59 g. (59–65%) of an octalone mixture (Note 4), b.p. 75–78° (0.2 mm.), 101–103° (2 mm.).

B.  $\Delta^{1(9)}$ -*Octalone-2*. A solution of 35 g. (0.23 mole) of the above octalone mixture in 200 ml. of 60–110° petroleum ether is cooled to –80° in an acetone-dry ice bath and kept at this temperature for 1 hour. The crystalline  $\Delta^{1(9)}$ -octalone-2 is filtered by suction through a jacketed sintered-glass funnel kept at –80°. The residue is washed with 100 ml. of cold petroleum ether, removed from the funnel, and recrystallized a second time in the same way. After the second recrystallization the white crystals are removed from the funnel, allowed to melt by warming to room temperature, and distilled. The yield of purified  $\Delta^{1(9)}$ -octalone-2 (Note 5), b.p. 143–145° (15 mm.), is 20–25 g. (34–46% based on starting enamine). The petroleum ether mother liquors can be distilled to yield a fraction boiling at 143–145° (15 mm.) which is enriched in  $\Delta^{9(10)}$ -octalone-2.

## 2. Notes

1. The enamine should be utilized as soon as possible after distillation.
2. A suitably purified dioxane can be obtained by distillation of reagent grade dioxane from lithium aluminum hydride.
3. Absolute ethanol and dry benzene are also useful solvents for enamine reactions. In this instance, however, the use of these solvents results in a lower yield of octalones.
4. The octalone mixture contains 10–20% of the  $\Delta^{9(10)}$ -isomer. This mixture may be used as such for many purposes.
5. The purified octalone still contains 1–3% of the  $\Delta^{9(10)}$ -isomer which cannot be removed even on further crystallization.

### 3. Discussion

The method of preparation used here is styled after the general procedure described for the reaction of enamines with electrophilic olefins.<sup>3</sup>  $\Delta^{1(9)}$ -Octalone-2 also has been prepared by condensation of 4-diethylamino-2-butanone with cyclohexanone; by condensation of 2-diethylaminomethylcyclohexanone with ethyl acetoacetate;<sup>4</sup> by condensation of methyl vinyl ketone with cyclohexanone;<sup>5</sup> by condensation of 4-oxo-1,1-dimethylpiperidinium salts with 2-carbethoxycyclohexanone;<sup>6</sup> by the oxidation of  $\alpha$ -decalones;<sup>7</sup> and by the reduction of 6-methoxytetralin.<sup>8</sup>

### 4. Merits of the Preparation

The present procedure is a general method for the preparation of monoalkylated ketones from enamines of aldehydes and ketones with electrophilic olefins.<sup>3</sup> There are many advantages in this method of alkylation. Generally only monoalkylation occurs, even when such reactive species as acrylonitrile are used; and, when a cyclic ketone like 2-methylcyclohexanone is used, reaction occurs only at the lesser substituted center. In a general base-catalyzed reaction, substitution occurs on the more substituted center.

Another advantage of this method is that no catalyst is needed for the addition reaction; this means that the base-catalyzed polymerization of the electrophilic olefin (*i.e.*,  $\alpha,\beta$ -unsaturated ketones, esters, etc.) is not normally a factor to contend with, as it is in the usual base-catalyzed reactions of the Michael type. It also means that the carbonyl compound is not subject to aldol condensation which often is the predominant reaction in base-catalyzed reactions. An unsaturated aldehyde can be used only in a Michael addition reaction when the enamine method is employed.

This preparation is referenced from:

- [Org. Syn. Coll. Vol. 9, 619](#)

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### References and Notes

1. Department of Chemistry, Seton Hall University, South Orange, New Jersey.
2. [S. Hünig, E. Löcke, and W. Brenninger, this volume, p. 808.](#)
3. G. Stork, A. Brizzolara, H. Landesman, J. Szmuszkovicz, and R. Terrell, *J. Am. Chem. Soc.*, **85**, 207 (1963); M. E. Kuehne, "Enamines in Organic Synthesis," in A. G. Cook (editor), "Enamines," Marcel Dekker, Inc., New York, 1969, Chapter 8.
4. E. C. DuFeu, F. J. McQuillin, and R. Robinson, *J. Chem. Soc.*, 53 (1937).
5. E. Bergmann, R. Ikan, and H. Weiler-Feilchenfeld, *Bull. Soc. Chim. France*, 290 (1957).
6. H. M. E. Cardwell and F. J. McQuillin, *J. Chem. Soc.*, 708 (1949).
7. H. H. Zeiss and W. B. Martin, Jr., *J. Am. Chem. Soc.*, **75**, 5935 (1953).
8. A. J. Birch, *J. Chem. Soc.*, 593 (1946).

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### Appendix

#### Chemical Abstracts Nomenclature (Collective Index Number); (Registry Number)

petroleum ether

$\Delta^{9(10)}$ -octalone-2

[ethanol \(64-17-5\)](#)

hydrochloric acid (7647-01-0)

Benzene (71-43-2)

ether (60-29-7)

sodium bicarbonate (144-55-8)

Cyclohexanone (108-94-1)

sodium chloride (7647-14-5)

Ethyl acetoacetate (141-97-9)

4-diethylamino-2-butanone (3299-38-5)

magnesium sulfate (7487-88-9)

dioxane (5703-46-8)

2-carbethoxycyclohexanone (1655-07-8)

acrylonitrile (107-13-1)

lithium aluminum hydride (16853-85-3)

methyl vinyl ketone (78-94-4)

2-methylcyclohexanone (583-60-8)

1-Morpholino-1-cyclohexene (670-80-4)

2(3H)-Naphthalenone, 4,4a,5,6,7,8-hexahydro-,  
 $\Delta^{1(9)}$ -Octalone-2,  
 $\Delta^{1(9)}$ -Octolone-2 (1196-55-0)

2-diethylaminomethylcyclohexanone

6-methoxytetralin (1730-48-9)